Concrete Decontamination by Electro-Hydraulic Scabbling (EHS)

Developer: Textron Defense Systems, Inc.
Contract Number: DE-AC21-93MC30164
Crosscutting Area: N/A

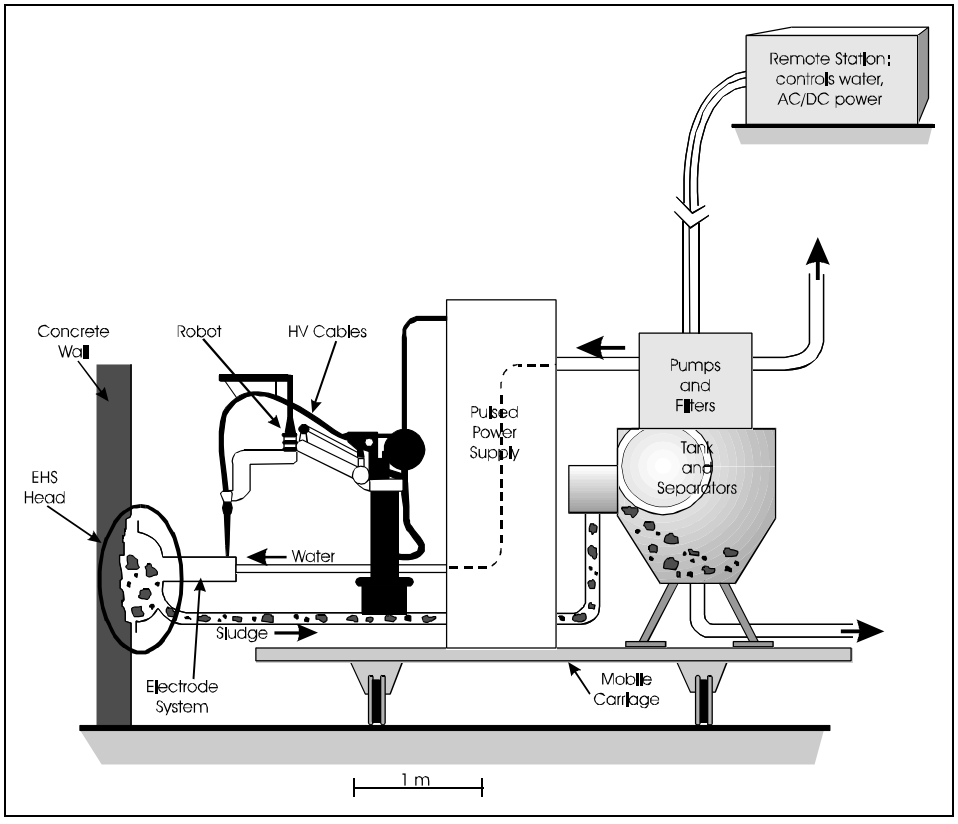
Deactivation & Decommissioning FOCUS AREA

Problem:

Contamination of concrete structures by radionuclides, hazardous heavy metals, and organic substances occurs at many Department of Energy (DOE) sites. In many instances the contaminants penetrate into the concrete to such depths that surface cleaning is not sufficient, but complete demolition of the concrete structure results in the generation of a large volume of contaminated and/or mixed waste which requires regulated disposal. The problems of cost and the logistics of the regulated disposal of such large quantities of mixed waste are significant.

Solution:

Development and demonstration of a cost-efficient, rapid, controllable concrete electro-hydraulic scabbling (EHS) process to remove surface layers of contaminated concrete while generating minimal secondary waste.



Benefits:

- Decontamination of deeply contaminated floors of massive concrete structures
- Reduction of waste (i.e., concrete and water) volume subject to regulated disposal
- Reduction of health and environmental hazards associated with decontamination/demolition process
- Reduction of decontamination costs due to lower labor cost and lower mixed-waste disposal cost

Technology:

This project included development of a scabbling process based on electro-hydraulic effects, i.e., the generation of controlled hydraulic shock waves by means of an electric discharge. The Electro-Hydraulic Scabbling (EHS) system was designed to be a cost-effective concrete decontamination process that will generate minimal quantities of contaminated secondary process wastes.

Scabbling is the physical removal of the concrete surface layer. It will serve to subdivide the mass of the

concrete structure into a) contaminated rubble of relatively small volume and b) the remaining clean concrete structure, which can either be reused or decommissioned by regular demolition techniques. In current scabbling techniques utilizing either mechanical grinding or high-pressure water jets, large amounts of contamnated dust and/or waste water are generated as part of the process.

The EHS device delivers strong pulses to the concrete surface by means of powerful shock waves originated by a pulsed high-voltage electric discharge. The hydraulic shock wave is propagated through water between the discharge channel and the concrete. The high impulse pressure developed at the liquid-solid interface results in stresses which can crack the surface layer. When electrodes are located very close to the surface, cavitational action of fast-moving liquid adds to the effect.

In the EHS scabbling head, the electric discharge takes place between two electrodes. Shock waves propagating through the water layer result in the concrete cracking and peeling. The depth of scabbling is controlled by changing the pulse energy, shape, and number of pulses per electrode position. Water not only provides efficient transfer of energy but also acts as a debris retainer and transport medium. The consumption of water in the EHS is much lower than in the high-pressure water jet decontamination technique. As illustrated in the figure, the EHS system is designed to be mounted on a carriage. Concrete rubble from the EHS head is retained in a tank and the water is cleaned and recirculated.

Project Conclusion:

The project was concluded in September 1997. At completion, no commitments to utilize this technology had been identified. An April 1997 subscale prototype demonstration at Florida International University showed that at a removal depth of 0.25 inch, the average scabbling rate was 0.7 - 0.8 square feet per minute of pulsing and repositioning the scabbling tool. An effective processing rate, including water handling, enclosure vacuuming and relocation and debris removal is 20 - 25 square feet per hour. There were no major equipment breakdowns during the test period. Daily average area processed was 80 square feet with a maximum of 100 square feet. Eventual processing rate, assuming required utilities are provided, working in an enclosed space, and elimination of minor hardware defects, is projected at 150 - 200 square feet per day. The developer believes that, although not yet ready for industrial-scale concrete decontamination, necessary improvements are rather straightforward.

A sub-scale demonstration held September 17-29, 1995, at Fernald, provided removal of 0.25 - 1 inch of concrete in a single pass. Scabbling to an average 0.375 inch depth resulted in an average of 10-20 times reduction of surface-measured radioactivity level (counts per minute) and total uranium content.

Contacts:

Textron Systems Division has developed a variety of applications of high-voltage pulsed discharge and pulse radiation technologies in lasers and treatment of gases and surfaces. For information on this project, the contractor contact is:

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